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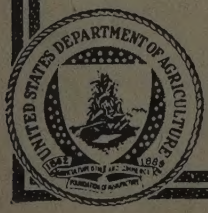
RABBIT PARASITES AND DISEASES



THE SUCCESSFUL RAISING of rabbits depends to a great extent on the ability to keep the animals free from parasites and bacterial diseases.

This applies particularly to those ailments which spread rapidly from one animal to another and take a heavy toll once they gain entrance to a rabbitry.

A study of the sanitary measures outlined in connection with rabbit feeding and the disposal of manure is also important.

Other factors which aid in keeping rabbits healthy are attention to ventilation and sanitary housing.

Washington, D. C. Issued December, 1928

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RABBIT PARASITES AND DISEASES

By BENJAMIN SCHWARTZ, *Senior Zoologist, Zoological Division,* and W. B. SHOOK, *Veterinary Inspector, Pathological Division, Bureau of Animal Industry*[1]

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PRINCIPAL CAUSES OF RABBIT AILMENTS

THE RABBIT INDUSTRY in the United States, though still in its infancy, has already assumed sufficient importance in certain parts of the country, especially on the Pacific coast, to warrant a serious consideration of the parasites and diseases of rabbits. In common with other animals under domestication, rabbits are subject to various pests, diseases, and ailments. The fact that rabbits are raised in close confinement from the time of their birth until they are sold or slaughtered renders them especially liable to parasitic diseases, many of which are acquired as a result of close contact with infested rabbits. A doe may harbor a few parasites that do not materially affect her health, but the transmission of the parasites to the young may give the latter a serious setback by stunting their growth, lowering their vitality, and, in the case of the more serious parasitic diseases, such as coccidiosis and ear mange, the young may die as the result of injury or from complete exhaustion of their vitality.

Before attempting to treat diseases or abnormal conditions, rabbit owners should make a thorough investigation of the cause. In the case of valuable animals and in the larger rabbitries the situation may necessitate consultation with an experienced veterinarian. This

[1]Acknowledgment is made of valuable suggestions and assistance from the Division of Fur Resources, Bureau of Biological Survey.

bulletin is published to furnish rabbit breeders with a practical knowledge of the more serious rabbit pests and diseases, together with methods of prevention and control. The discussion is divided into two main sections, dealing with parasites and bacterial diseases, respectively.

RABBIT PARASITES AND THEIR CONTROL

By Benjamin Schwartz

Among the parasitic diseases of rabbits those which deserve special attention are coccidiosis, ear mange or ear canker, skin mange, and stomach-worm diseases. The common results are weakness, emaciation, wasting, and death. Other parasitic affections, such as irritations caused by fleas, lice, and intestinal worms of various sorts, while not commonly producing very marked symptoms in infested animals, may gradually render them weak and unthrifty, making them more susceptible to other diseases as a result of their lowered vitality.

Treatment of certain rabbit diseases, except in the case of valuable show animals, should not be undertaken by breeders, as a rule, when but a few animals are affected. The sacrifice of one animal or a few animals affected with skin mange, coccidiosis, or parasitic worms is a simpler and often a safer procedure than a tedious course of treatment, with the danger of spreading disease to unaffected animals, especially in view of the fact that for some parasitic infestations of rabbits no effective treatments are known at the present time.

The treatment of animals for infestations with external and internal parasites or for other diseases is the business of the veterinarian, and when disease is present among rabbits breeders should seek his professional advice. The drugs used for treating external and internal parasites are in many cases highly poisonous substances, and questions of dosage, frequency of treatment, and whether a given animal should be treated at all are best solved by a veterinarian whose professional training, experience, and personal skill render him competent to handle such problems.

The prevention and control of disease is, however, the business of the breeder, and so far as concerns parasitic diseases of rabbits, control and prevention are often more practical than treatment. Prevention and control measures are usually matters of sanitation, in the broad sense of the word, and in the case of parasitic disease such measures must be based on a knowledge of the habits and life histories of the parasites involved and on their mode of transmission from one animal to another.

In dealing with parasitic diseases of rabbits, breeders should bear in mind that many of these diseases are spread from one animal to another either through close contact, as in the case of ear mange, skin mange, and infestations with lice, fleas, and other external parasites, or through the use of infested areas, especially in connection with the droppings, as in the case of coccidiosis and the diseases caused by certain worms that live in the digestive tract, since parasite cysts and eggs pass in the droppings. Prevention of mange and various skin parasites consists primarily in isolating and treating the affected animals or else killing them, followed by deep burial of the carcass or

by cremation, and then thoroughly disinfecting their quarters and the adjoining quarters of other animals. Prevention of internal parasites, such as coccidia and worms, consists partly in thorough and frequent cleaning of hutches, since the infectious stage of the organisms causing these diseases develops in the droppings. The droppings should not be used to manure ground on which rabbit feed is grown, but should be destroyed by burning or should be plowed under on areas remote from where the feed is grown, as otherwise these disease organisms, many of which are long-lived and very resistant, will be introduced into the hutches with the feed.

EXTERNAL PARASITES AND PARASITIC SKIN DISEASES

External parasites live on the skin or else in or under the skin in burrows that open to the external surface. These parasites include (1) insects such as fleas, lice, and bots and (2) mites, which are small arthropods closely related to insects. The parasites that cause ear mange and skin mange in rabbits are mites.

MANGE

Rabbits are subject to four varieties of mange, namely, two forms of ear mange, commonly known to rabbit breeders as ear canker, which may be produced by two different types of parasitic mites, and two forms of general body mange or skin mange which may also be produced by two types of mites. The ear mange mites live among the scales and crusts which they produce as a result of pricking the skin superficially, whereas the mites producing general body mange or skin mange burrow into the skin; the latter are, therefore, more difficult to reach with medicinal applications than the former.

Mites reproduce by means of eggs which are deposited by the female. The eggs may be found in or under the scabs or in the burrows of the skin, and their detection in skin scrapings is sufficient to warrant a diagnosis of mange. The eggs hatch and the larvae have the same shape as the adults and are distinguished by the fact that they are smaller and have only six legs, whereas the adults are larger and have eight legs.

EAR MANGE

Cause.—The most common cause of ear mange in rabbits is a mite[2] (fig. 1) that is very closely related to mites that occur on horses, cattle, and other animals, the largest specimens of which are slightly more than one-fiftieth of an inch long. The mites are oval in shape, and the legs are visible outside the margin of the body when viewed from above. The disease produced by these mites is known as psoroptic mange. The other form of ear mange in rabbits, known as chorioptic mange, is produced by another species of mite[3] which is closely related to forms occurring on various domestic animals. This mite is somewhat smaller in size than the previous species, has very long legs that are visible outside the margin of the body when viewed from above, is oval in shape, and, so far as concerns habits and life history, resembles in most respects the organism that pro-

[2] *Psoroptes communis cuniculi.* [3] *Chorioptes cuniculi.*

duces psoroptic mange. The symptoms of chorioptic mange are similar to those of psoroptic mange, but the disease is usually less serious.

Symptoms.—In rabbits ear mange is generally confined to the ears (fig. 2), but the resulting inflammation may spread to the coverings of the brain. In exceptional cases the organisms of psoroptic mange have been found on the face, neck, and legs. The mites produce intense irritation and itching and a catarrhal condition of the external auditory canal, the discharge being brownish in color and having a distinct odor. The inside of the ear becomes caked with the discharge, and as a result of bacterial infection ulceration of the ear may be produced. The parasites often penetrate into the middle

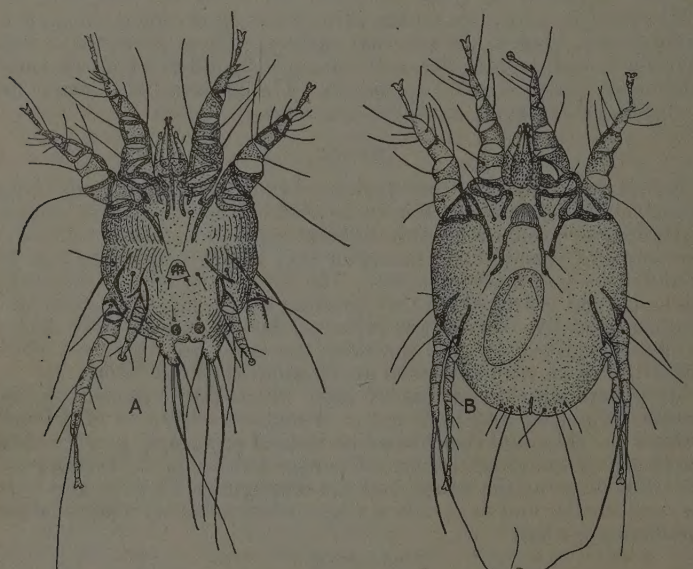

FIG. 1.—The psoroptic mange mite of rabbits (*Psoroptes communis cuniculi*) viewed from underside. (From Canestrini, 1894.) Enlarged. A, Male; B, female

ear and sometimes even into the inner ear, in which cases they produce serious nervous disturbances. Shaking the head is a common symptom of ear mange. Owing to the irritation produced by the parasites, affected rabbits usually flap their ears and try to scratch inside their ears with their hind feet. In case the parasites penetrate the middle and inner ear, the head may be held in an oblique position. In a severe condition of this sort the twisting of the head has been found to be so pronounced that the lower jaw is uppermost. The disease is very contagious and generally runs a long course, sometimes for several months. Despite the fact that mature animals affected with ear mange usually eat well, they lose flesh. In advanced, untreated cases of ear mange young rabbits may become greatly emaciated and lose their appetites and may die in convulsions. In exceptionally severe cases the inflammation may extend to the

coverings of the brain, and when this complication arises the animals die in a very short time. Old animals show a greater resistance to this disease than young ones.

Treatment.—Treatment for ear mange is relatively simple. The ear may be cleansed thoroughly with hydrogen peroxide, and all loose caked discharge and scab carefully removed. If one of the following treatments is applied, the oil used will soften the scab, which can then be easily removed. The affected parts are treated with an oil mixture, containing 20 parts of olive oil and 1 part of carbolic acid or cresol. Several treatments with this mixture may be necessary to effect a cure. After each treatment remove whatever scab material becomes loose. A method which is said to give invariably good results consists in dropping into the ear, every two or three days, 7 or 8 drops of a mixture of a bland oil, petroleum benzene, and kerosene. (All these ingredients are not absolutely necessary and the proportion used of each may also vary.) After several treatments the dropping of this mixture into the ear may be reduced to two applications a week until the trouble disappears.

FIG. 2.—Rabbit's ear, showing mangy crusts. (From Moussu)

The following treatment has been used successfully by the Bureau of Biological Survey in curing ear mange in fur-bearing animals, including rabbits. Prepare a mixture of 1 part iodoform, 10 parts ether, and 25 parts olive oil, petroleum, or cottonseed oil. Saturate a piece of cotton with this mixture and apply with the aid of a stick to the affected parts, the solution being allowed to run into the ear. A second application is given from 7 to 10 days after the first treatment.

Other treatments known to be effective in ear mange in dogs may be tried, and the following preparations are recommended as worthy of trial: (1) 1 per cent solution of carbolic acid or creosote in glycerin; or (2) 5 per cent carbolic acid in olive oil or castor oil. Any one of these preparations may be applied with a cotton swab or by flooding the ear, and the treatment repeated until the animal is cured. Hutches in which rabbits affected with ear mange have been kept should have all litter and straw removed from them and should be thoroughly cleaned with a hot insecticidal solution of adequate strength in order to destroy any mites that may have survived in cracks and crevices. For this purpose coal-tar-creosote dips are useful. Unless this precautionary measure is taken the disease may reappear after treatment has been stopped.

SKIN MANGE

Cause.—Skin mange in rabbits may be produced by two different species of mites, one species[4] (fig. 3) producing a form known as sarcoptic mange and the other species[5] (fig. 4) producing a form known as notoedric mange. These two species of mites are closely related to forms occurring on various domestic animals. Sarcoptic and notoedric mange in rabbits are closely related diseases, producing

[4] *Sarcoptes scabiei cuniculi.* [5] *Notoedres minor cuniculi.*

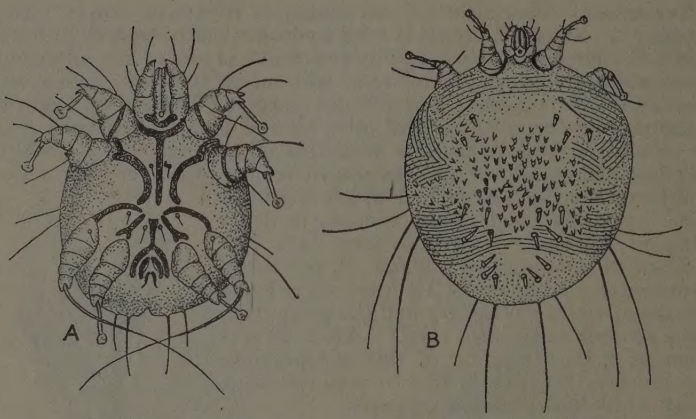

FIG. 3.—The sarcoptic mange mite of rabbits (*Sarcoptes scabiei cuniculi*). (From Canestrini, 1894.) Enlarged. A, Male, viewed from underside; B, female, viewed from above

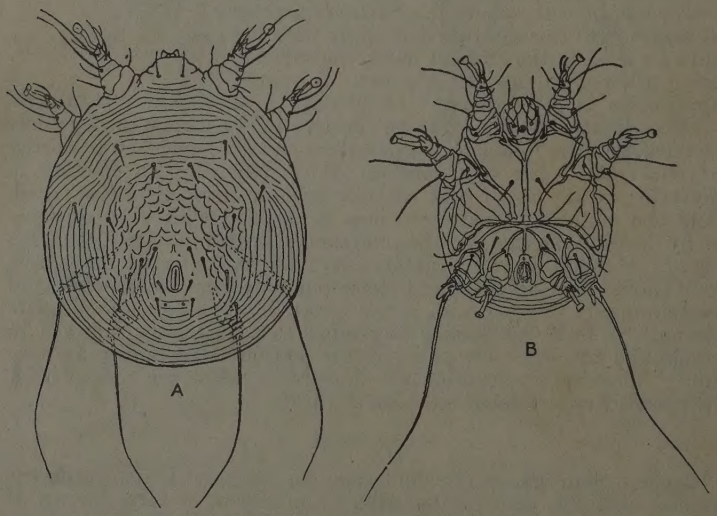

FIG. 4.—The notoedric mange mite of rabbits (*Notoedres minor cuniculi*). (From Hirst, 1922.) Enlarged. A, Male, viewed from above; B, female, viewed from underside

practically the same type of lesions. Sometimes the body of a rabbit may be affected with a combination of sarcoptic and psoroptic mange, the latter spreading from the ears to other parts of the body. The mites that produce skin mange are very small, being less than one-fiftieth of an inch long. They burrow deep in the skin, the female mites depositing their eggs in the burrows, where the young develop. In view of the location of these mites superficial skin scrapings often fail to reveal their presence. Rabbits suspected of harboring these mites should be scraped with the dull edge of a knife until blood is drawn and the scrapings should be examined by a competent zoologist or veterinarian for the presence of the parasites. It is very important to diagnose sarcoptic and notoedric mange early in order to prevent the diseases from spreading, as treatment is tedious and difficult.

Symptoms.—The presence of mites in the skin leads to serious alterations of the tissue due to the burrowing habit of these parasites. As the mites burrow, a serous exudate is formed, and it is the dried-up exudate that produces the characteristic scab. The skin irritation produced by the mites in various animals gives rise to constant itching, the animals scratching and rubbing the affected parts and thus producing open sores which may become infected. These are the outstanding symptoms and the ones which should lead the breeder to suspect the presence of mange. In sarcoptic mange of the rabbit the lesions occur on the tip of the nose, which may be transformed into a kind of proboscis, also on the lips, chin, forehead, ears, and legs, and may then spread to other parts of the body. The fur falls off, revealing grayish or yellowish crusts which stick closely to the skin. Sarcoptic mange in rabbits is a very contagious disease, and if not checked it will spread rapidly and kill the affected animals in the course of several weeks. In the last stages of the disease the animals are unable to eat, and they may die as a result of severe emaciation and complete exhaustion. Notoedric mange in rabbits first appears on the nose, then reaches the lips, the forehead, the face, especially round the eyes, and even the ears. It spreads to below the lower jaw and the extremities of the legs and produces skin itching and skin alterations similar to those observed in sarcoptic mange. (Fig. 5.)

FIG. 5.—Rabbit's face affected with mange. (From Moussu)

Treatment.—Unless very valuable show animals are involved it is not advisable to undertake treatment for skin mange in rabbits. As soon as the disease is definitely diagnosed, the affected animals should be killed, and the carcasses should be buried deep or, preferably, cremated. The hutches occupied by infected animals should be thoroughly disinfected with hot, strong, coal-tar disinfectants, and all litter in the hutches should be burned. The animals in adjoining hutches should be isolated and kept under observation for

several weeks, and the hutches occupied by them should also be thoroughly disinfected.

When it is considered desirable to undertake treatment, hygenic conditions, such as good feed and fresh air, are great aids. The hair over the diseased area, and preferably over the entire body, should be clipped, and the exposed crusts should be softened by being rubbed with green soap and a little warm water, which should be left on for an hour or two and then washed off with warm water. Much washing and bathing should be avoided. Rubbing in cod-liver oil in order to soften the scabs has also been recommended. Sulphur ointment, consisting of 1 part of sulphur to 3 to 4 parts of lard, or other preparations to be mentioned later, should be thoroughly rubbed into the affected parts every four or five days until a complete cure is effected. Inasmuch as less is known about the treatment of mange in rabbits than in some other animals, the following remedies known to be effective against mange in other animals are recommended as worthy of trial in rabbitries, the course of treatment being similar to the sulphur-ointment treatment: 1 part each of oil of tar and green soap in 1 to 5 parts of alcohol; or 1 part each by volume of oil of tar and crude petroleum oil and 6 parts of liquid petroleum; or flowers of sulphur 2 parts, oil of tar 1 part, potassium carbonate 1 part, and lard 8 parts; or flowers of sulphur 150 grams, potassium carbonate 8 grams, lard 60 grams; or flowers of sulphur 1 part, tincture of iodine 1 part, oil of tar 8 parts, and olive oil 8 parts.

After handling a mangy rabbit it is advisable for the person who administered the treatment to rub his own hands with the ointment to prevent becoming infected, as some forms of mange on animals may produce a slight infection in man.

WRY NECK

The condition known as wry neck is sometimes related to ear canker and is characterized by the rabbit's holding its head to one side, the symptoms gradually growing worse until the animal, no longer able to maintain its equilibrium, rolls over. In severe cases the rabbit is said to be unable to stand up and may die as a result of inability to eat.

Cause.—In addition to being associated with serious cases of ear mange, inflammation of the inner ear, and other things, wry neck or limber neck, as the condition is commonly called, is also said to be caused by a mite[6] (fig. 6), which occurs accidentally in the ears of rabbits. These mites occur normally in rabbit houses and buildings and swarm in hay, straw, fodder, in some grains, dried fruits, and in many other food substances. On getting into the ear of a rabbit the mites are apparently able to maintain themselves and to set up the diseased condition described above.

Treatment.—Treatments similar to those recommended in connection with ear canker should be used. Systematic dressing of the ears with a weak liniment of carbolic acid, turpentine, and tincture of opium in glycerin has been recommended as effective. If this disease occurs in a rabbitry, measures should be taken to examine the supplies of hay and other feed for mites of this species or to procure supplies known to be safe.

[6] *Glyciphagus domesticus.*

LICE

Louse infestation may occur in badly managed rabbitries and is especially common on badly nourished and weak individuals.

Cause.—The rabbit louse [7] (fig. 7) is a bloodsucker and produces anemia and emaciation in cases of heavy infestation. The eggs or so-called nits are fixed solidly to the hairs by means of a gluey substance secreted by the louse. The young leave the eggs through an opening at one end of the eggshell. They have the general shape of the adults, and become adults gradually after several molts. Lice remain on their host throughout their life, being incapable of remaining alive for any length of time elsewhere.

Symptoms.—Lice produce great irritation of the skin as a result of their bites, causing the affected animal to rub, scratch, and bite itself in order to obtain relief. This constitutes a great drain on the animal's energy, its fur becomes ragged and covered with nits,

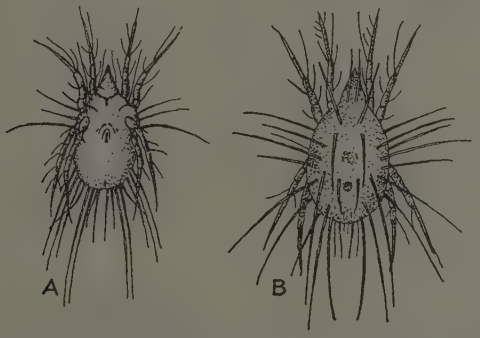

FIG. 6.—Mite (*Glyciphagus domesticus*) causing wry neck in rabbits. (From Pillers, 1920.) Enlarged. A, Male, viewed from underside; B, female, viewed from above

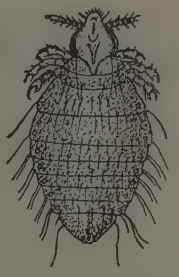

FIG. 7.—The rabbit louse (*Haemodipsus ventricosus*). (From Railliet, 1895.) Enlarged

and the skin becomes inflamed, showing reddened patches which are frequently aggravated by the animal's scratching itself.

Treatment.—In order to give a rabbit immediate relief the following treatment known to be effective in lousy dogs and other lousy animals may be used: The hair should be dusted with fresh pyrethrum powder, which should be allowed to remain for about a half hour, and then be brushed out with the dead and stupefied lice on to a piece of paper which should be burned. This treatment, which should be applied next to the skin or throughout the hair, may be repeated several times. More effective measures for the destruction of lice which have been found successful in treating dogs for lice consist in rubbing in oils, such as cottonseed oil, olive oil, or various vegetable oils used in cooking, allowing the oil to act for an hour or so, and then washing it off with warm water and soap or, preferably, removing it with bran. As a rule this treatment will kill both lice and eggs. If it does not do so, the treatment should be

[7] *Haemodipsus ventricosus.*

carried out twice, with an interval of about 10 days between, to destroy any lice that may have hatched out from the eggs after the first treatment.

FLEAS

Cause.—Three species of fleas are known to attack hutch rabbits in Europe. In the United States fleas on domestic rabbits are apparently rare, so far as present knowledge goes, an exception being the sticktight flea. One of the species[8] (fig. 8) of fleas known from rabbits is the true rabbit flea, the other species being the dog flea,[9] the cat flea,[10] the human flea,[11] and the sticktight flea.[12] * * * The last-mentioned flea is normally a parasite of poultry and is sometimes of considerable importance as a parasite of domestic rabbits in the Southern and especially the Southwestern States. The eggs of the flea develop in dirt and trash in the hutches and give rise to elongated larvae after a few days' incubation. The larva moves about by crawling and feeds on animal and vegetable débris. After a few days the larva spins a cocoon, gets rid of its old skin, and finally emerges as an adult flea. The adult fleas feed exclusively on the blood of the host.

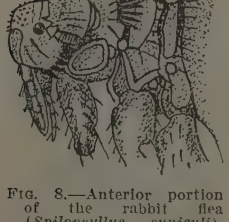

FIG. 8.—Anterior portion of the rabbit flea (*Spilopsyllus cuniculi*). (From Railliet, 1895.) Enlarged

Symptoms.—Fleas are known to attack especially the young, weak, and confined animals. They produce great irritation by their bites, causing intense itching and loss of sleep, and act as a drain on nervous energy.

Treatment.—Effective treatment against fleas should include not only the destruction of the adult flea but also simultaneously the cleansing of the premises and the destruction of the eggs and larvae. The animals should be dusted with pyrethrum powder, with powdered naphthalene, or powdered Derris root, which should be used as was recommended in connection with treatment for lice with pyrethrum, or treated with one of the bland oils recommended for destroying lice. The living quarters should be well scalded with boiling water or sprayed with a good grade of coal-tar-creosote dip containing between 10 and 16 per cent of tar acids to destroy the eggs, larvae, and pupae. As a preventive measure against fleas on rabbits, dogs, cats, and poultry infested with fleas should not be allowed to have free access to the area occupied by rabbit hutches.

CHIGGERS

In well-managed rabbitries chigger infestation is probably rare. The possibility of the occurrence of chigger infestation, however, should be considered and prompt measures taken to relieve infested animals, as suffering from this condition is usually intense when many chiggers are present. Chiggers may be introduced into rabbit hutches by feeding grass or lawn clippings from infested areas.

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[8] *Spilopsyllus cuniculi.*
[9] *Ctenocephalus canis.*
[10] *Ctenocephalus felis.*
[11] *Pulex irritans.*
[12] *Echidnophaga gallinacea.*

Cause.—The common American chigger [13] and related species are known to attack wild rabbits and doubtless will attack domestic rabbits. The parasites attach to the skin, engorge themselves with blood, and ultimately fall off.

Symptoms.—Chiggers produce intense itching as a result of their bites, thus causing the infected animals to rub and scratch themselves. The continuous rubbing and scratching produce skin sores which may become infected with bacteria.

Treatment.—Chigger infestation may be treated with repeated applications of alcohol. To alleviate itching, ammonia or sodium bicarbonate solution may be applied.

Chiggers live in underbrush and rank vegetation, and prevention consists in clearing the ground in and around rabbitries and keeping it free from rubbish which may afford shelter.

FIG. 9.—Rabbit bot (*Cuterebra* species). From Osborn, 1896)

WARBLES

Warbles or bots (fig 9) are common in wild rabbits and also occur occasionally in domestic rabbits. Warbles are the larvae of flies [14] (fig. 10) and occur between the skin and the flesh beneath, forming a lump, sometimes an inch long or even longer. Warbles in rabbits originate from eggs deposited by the adult flies on the rabbit's hair. The larvae are probably taken in by way of the mouth in some cases, but little is known about most species. In due time the warbles emerge from beneath the skin and the scar ultimately heals. If warbles are detected in rabbits they may be removed by slightly enlarging the opening in the skin with a sterilized knife and drawing them out with forceps. The cavity from which the grubs have been removed should be treated with a 1 per cent solution of cresol applied with a cotton swab.

FIG. 10.—Adult rabbit bot fly (*Cuterebra cuniculi*). (From Osborn, 1896.) Enlarged

INTERNAL PARASITES

Internal parasites live in the tissues or cavities of the bodies of animals that serve as hosts for the parasites. Internal parasites of rabbits include very minute organisms known as Protozoa and such larger animals as tapeworms and roundworms. Protozoa are usually not visible to the naked eye and can be detected only with the aid of the microscope. Worms are usually visible to the naked eye, but in view of their usual location in the alimentary canal or in some other part of the body their presence in most cases can be detected only with the aid of the microscope. This is done by examining the droppings for the eggs produced by

[13] *Trombicula irritans.* [14] *Cuterebra cuniculi* and related species.

the female worms and expelled from the body with the droppings; these eggs are microscopic in size.

PROTOZOA

Protozoa are minute forms of animal life, the individual consisting of but a single cell. Although a number of species of Protozoa are known to occur in rabbits, the only forms known to be definitely injurious to them are coccidia and certain flagellates. A protozoan blood parasite [15] from rabbits is known, and what may be this species has been found in Canada. Some zoologists regard it as harmless, but others consider it capable of causing profound weakness, emaciation, and even death. Pending further study, it is not given special consideration here.

COCCIDIOSIS

Coccidiosis is one of the most important and serious diseases of rabbits. It is of very common occurrence in wild and in domestic

FIG. 11.—Rabbit's liver spotted with coccidia. (From Moussu)

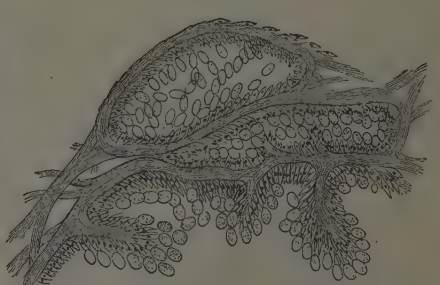

FIG. 12.—Section of rabbit's liver showing numerous coccidia. (From Railliet, 1895.) Enlarged

rabbits, one of the greatest drawbacks to the study of this disease being the difficulty of finding rabbits that are entirely free from it. All rabbits that harbor the organism of coccidiosis do not show symptoms of the disease. Many rabbits, especially grown ones, are merely carriers of the organisms, and although they are but little, if at all, inconvenienced by the parasites that they harbor, they transmit the disease to their young through the droppings. In young animals coccidiosis is liable to produce a serious condition and may cause their death.

Cause.—The cause of coccidiosis is a very minute animal parasite visible only through the microscope. The parasites are known as coccidia and occur usually in the liver (figs. 11, 12, and 13) and in the cells lining the intestine; they have also been reported to occur in the nose and in other locations, and on rare occasions have been reported from the eye. Two species of these parasites are common in rabbits, one of them producing liver coccidiosis and the other

[15] *Trypanosoma cuniculi.*

producing intestinal coccidiosis. Coccidia gain entrance into rabbits with feed or drink that has become contaminated with the droppings of infected rabbits. They pass out of the body with the droppings, and in cases in which they affect the nose they are said to pass out with the nasal discharges.

LIVER COCCIDIOSIS

A condition due to the presence of coccidia[16] in the liver is generally known to rabbit breeders as spotted-liver disease. The whitish spots on the liver are masses of coccidia embedded in a creamy material. At a certain stage in their development, the parasites pass from the liver into the intestine through the bile ducts and are eliminated from the intestine with the droppings. The stage which occurs in the droppings is known as an oocyst, and is very resistant to ordinary drying, surviving this for several days, but will not resist actual dessiccation. It is also resistant to other usually injurious influences.

Symptoms.—Rabbits affected with liver coccidiosis may become weak, anemic, and pot-bellied, and may lose flesh, though some show

FIG. 13.—Stages in the development of the coccidial cyst (*Eimeria stiedae*). (From Hegner and Taliaferro, 1924.) Enlarged

no apparent symptoms. As the disease progresses affected rabbits may become more and more dull and listless, lose their appetite, and become greatly emaciated, the fur becoming rough, dull, and easily pulled out. This condition may last for two or three months and unless it clears up the symptoms become aggravated; the animals develop a staggering gait, a very pronounced anemia, and finally die in convulsions.

INTESTINAL COCCIDIOSIS

Intestinal coccidiosis resembles liver coccidiosis, the two often existing together in the same animal. In intestinal coccidiosis the parasites[17] are entirely or largely confined to the mucous cells of the intestine. The cysts of the resistant stage are discharged with the droppings, as in liver coccidiosis, and serve to transmit the disease from rabbit to rabbit.

Symptoms.—Animals dead of intestinal coccidiosis show whitish spots of variable size on the mucous lining of the small intestine. These spots are caused by the accumulation of coccidia in the cells lining the intestine. The mucous membrane of the intestine is in-

[16] *Eimeria stiedae.* [17] *Eimeria perforans.*

flamed and sometimes ulcerated, and is covered with a discharge containing coccidia.

Intestinal coccidiosis produces practically the same effects upon the animals as liver coccidiosis. The rabbits lose their appetite, become emaciated, and suffer from diarrhea, the last-named symptom being especially characteristic of intestinal coccidiosis. Sometimes intestinal coccidiosis runs a long course, but in cases of very heavy infestation of the intestine death may occur in a few days after the onset of the disease. Intestinal coccidiosis is primarily a disease of young animals.

NASAL COCCIDIOSIS

Although this condition has been reported by several investigators, and is reported as occurring in the United States, it requires additional study. It is said to be caused by the presence of coccidia in the lining of the nasal canals and produces, according to published reports, an acute condition that has been designated as a malignant catarrh. Nasal coccidiosis should not be confused with snuffles, which is a bacterial disease. The two diseases may be differentiated by examining the nasal discharges with the microscope. If coccidia are involved the organisms may be detected with the microscope. The presence of coccidia in a nasal discharge might indicate merely a contamination of the discharge with coccidia from the droppings. If coccidia are absent, then the condition is usually due to bacteria.

Symptoms.—The symptoms of nasal coccidiosis, as described by different investigators, are similar to those of liver and intestinal coccidiosis and consist in lack of appetite and general dullness. In addition to those symptoms there is sneezing and much coughing, with a discharge from the nose, which is at first watery and later mucoid. The discharge from the nose glues the nostrils together and spreads to the fur of the breast and forelegs, to which it adheres. The temperature rises to 104° or 105° F. and breathing becomes difficult and is accompanied by considerable panting and pumping. Following great emaciation and weakness, convulsions set in, which terminate in death. The mucous lining of the nose is greatly inflamed and is covered with an orange-colored discharge which contains coccidia. Not only the mucous lining of the nose, but also the middle ear and pharynx may be affected by the coccidial organisms.

Coccidiosis of the nose usually occurs with intestinal and liver coccidiosis, but the method of infection of the nose with coccidia is not known at the present time.

Diagnosis.—Coccidiosis may be diagnosed from the symptoms, but the diagnosis should be confirmed by a microscopic examination of the feces, or of the nose discharges in the case of nasal coccidiosis. Coccidiosis should be suspected in rabbits that appear dull, listless, and unthrifty, and that suffer from diarrhea.

Prevention.—Preventive measures consist in keeping the hutches clean by removing the manure every day. Hutches with false bottoms consisting either of wooden slats or metal gratings that enable the pellets to drop through into a suitable receptacle will greatly aid in controlling coccidiosis, and have been found of great practical value in the control of this disease. Food and water containers should be placed above the bottom of the hutch to prevent their

becoming contaminated with feces. However, irrespective of the type of hutch used, they should be thoroughly cleaned at least three times a week, as the coccidial cysts may develop under favorable conditions in two days and become infectious to other rabbits. Cleaning should be thorough, and hot water should be used if possible, as the cysts are ordinarily resistant to chemical disinfectants but are killed by heat. Hot water below the boiling point does not kill the cysts instantly, but at a temperature slightly above 131° F. the cysts are killed in about 30 minutes. Boiling water kills them rather quickly, and if live steam can be used it should be highly effective. The cysts are resistant to ordinary chemicals used for disinfection. A 3 per cent solution of cresol may kill the cysts in about 2 hours, but a longer period of 36 hours has been found necessary to insure their destruction.

Coccidiosis is frequently introduced into rabbitries with secondhand hutches. As a precautionary measure secondhand hutches should be scalded, scrubbed with boiling water and strong lye, rinsed with boiling water, and finally dried with a gasoline blowtorch or by exposure to sunlight for several days in warm weather. Care should be taken that the boiling water reaches all cracks and crevices of the hutches.

Coccidiosis may also be introduced with feed grown on ground that has been manured with rabbit feces and with green feed collected in ditches and other places that have become contaminated with feces of infected wild rabbits. Coccidia are more likely to be introduced into the rabbitry with green feed than with dry feed, such as alfalfa hay. The cysts do not live more than a few days after they have become dry. Green feed contaminated with coccidia is dangerous to rabbits and should under no circumstances be introduced into hutches.

Since adult rabbits harboring coccidia may show no symptoms of the disease but still serve as carriers and transmit the disease to young animals with which they come in contact, it is very important to isolate young rabbits from older ones. There is some danger, also, that coccidiosis may be introduced by bucks used for service. Because of this possibility and other reasons incident to good management, persons in charge of well-conducted rabbitries do not permit bucks to remain in breeding pens any longer than is necessary for mating.

In all cases sick and suspected animals should be isolated, and the carcasses of animals that died of coccidiosis should be destroyed by cremation. The feces of animals harboring coccidia should be destroyed, preferably by burning.

Since young animals are especially susceptible to parasites, including coccidiosis, and to the bad effects of parasitism, it is advisable to raise young rabbits away from older animals, other than the mothers, and away from the areas used by older animals, as far as possible. Young animals are special cases and require special care to tide them over the danger period of infancy and youth to the point where they have the hardiness and relative immunity to parasites of the older animals.

There is no treatment for coccidiosis in rabbits that has been tested on a sufficiently large number of animals to warrant its recommendation to rabbit owners. Quinine has been recommended as a remedy

for coccidiosis in doses of one-tenth of a grain daily until the symptoms disappear. For internal administration quinine sulphate has been recommended, and for nasal coccidiosis quinine hydrochloride in solution is said to give good results. Until these drugs have been tested on a large series of animals nothing definite can be said as to their value in the treatment of coccidiosis.

INTESTINAL FLAGELLATES

A serious disease of rabbits has been described as being due to intestinal flagellates.[18] (Fig. 14.) These organisms occur in the small intestine and adhere firmly to the cells lining the intestine. The nature of the disease produced by these parasites is obscure. Affected animals die within a few hours or a few days after the appearance of the symptoms. Young rabbits may succumb within a few hours after symptoms appear, and old rabbits may live for several days. They refuse to eat, however, and have distended abdomens; post-mortem examination reveals putrefaction in the stomach. Until more is learned concerning this disease and its treatment, no recommendations can be made as to medicinal applications to be used. Prevention of the spread of these intestinal flagellates consists in following precautions similar to those recommended in connection with the control of coccidiosis, as the two diseases are spread in a similar manner.

FIG. 14.—An intestinal flagellate (*Giardia duodenalis*) of rabbits. (From Hegner and Taliaferro, 1924.) Enlarged

WORMS

Worms occurring in rabbits are of three kinds, namely, tapeworms, flukes, and roundworms. Tapeworms occur in rabbits as adults in the intestine and as larval forms, known as bladder worms, in various locations in the body outside the alimentary canal. Flukes occur in rabbits in the small intestine and in the liver. Roundworms are slender, cylindrical worms, and those in domestic rabbits occur in the digestive tract, including the stomach, small intestine, large intestine, and cecum, and also in the lungs.

Worms in all animals act as a constant drain on the energy of the host, cause irritation of the lining of the alimentary canal, lungs, and other parts as a result of their bites or their adherence to the lining, and produce weakness, emaciation, and anemia. They commonly predispose affected animals to other diseases by lowering the vitality.

Worms are especially injurious to young animals and stunt their growth. Whenever unthriftiness, lack of appetite, diarrhea, anemia, and similar symptoms are present in rabbits, in the absence of coccidiosis, worms should be suspected.

While the extent of the injuries produced by worms in rabbits is not definitely known, inasmuch as the worm parasites of these animals have not been extensively studied, it may be concluded from the kinds of worm parasites known to occur in rabbits that they do some harm and in certain cases they probably do considerable harm.

[18] *Giardia duodenalis.*

Worms in rabbits are in some cases closely related to worms occurring in cattle, sheep, and goats; and in these animals related worm infestations are often very serious.

TAPEWORMS

Larval tapeworms in domestic rabbits may occur in the liver and abdominal cavity, between the muscles, and under the skin, and are common, whereas the adult forms occur exclusively in the small intestine, and are not likely to be very common in hutch rabbits.

Intestinal tapeworms

Several species of tapeworms have been found in the intestines of rabbits, including domestic rabbits, the largest forms attaining a length of about 30 inches, but they are usually only half that length or less. A rabbit tapeworm (fig. 15) is flat, whitish, and ribbon-shaped, being made up of numerous segments, which are wider than they are long, and a head provided with four suckers, by means of which the worm is attached to the lining of the intestine. The oldest and ripest segments are those farthest from the head. Sooner or later the ripe segments, each of which contains numerous eggs, become detached from the rest of the tapeworm and pass out with the droppings, and this process is repeated throughout the life of the tapeworm. Beyond this point nothing is known concerning the development of these tapeworms.

FIG. 15.—An intestinal rabbit tapeworm (*Cittotaenia ctenoides*). (From Stiles, 1896.) Half natural size

As a general rule rabbits harboring one or a few tapeworms are not materially affected. When many tapeworms are present in the small intestine there are sometimes disturbances of digestion, more or less diarrhea, anemia, and emaciation. In cases of gross infestation death may occur as a result of extreme emaciation and severe anemia.

As a rule tapeworm infestation in hutch rabbits escapes detection unless the droppings are carefully examined for the presence of the whitish, ripe segment, which can be seen readily with the naked eye. If tapeworm segments are found, the feces of affected animals should be plowed under or destroyed by burning in order that spreading the disease be avoided, as the eggs in these segments constitute the starting point for fresh infections.

Very little is known regarding the treatment of rabbits for tapeworm infestation. The admixture of freshly ground areca nut with the feed has been recommended as a remedy for tapeworms in rabbits, but the value of this treatment is not well established. The minimum dose for a very young animal is one-fourth of a gram and the maximum dose for a fully grown animal is 1 gram, with proportionate doses for animals of intermediate sizes.

Bladder worms

The form that occurs in the liver and in the abdominal cavity [19] (fig. 16) is the single-headed bladder worm (cysticercus), which is much more common than that which occurs under the skin [20] (fig. 17), and which is the many-headed bladder worm (cœnurus).

FIG. 16.—Fragment of mesentery of rabbit containing bladder worms (*Taenia pisiformis*). (From Railliet, 1895.) Approximately natural size

Rabbits acquire an infestation with bladder worms as a result of swallowing, in contaminated feed or water, the tapeworm eggs that are eliminated with the feces of dogs harboring the adult stage of these tapeworms. The young embryo present in each egg is released from the shell in the digestive tract of rabbits, bores through the wall of the digestive tract, and ultimately reaches its preferred location. Dogs in turn acquire an infestation with the adult tapeworms as a result of eating the bladder worms in the entrails, other viscera, and flesh of infected rabbits. The feces of dogs harboring the adult tapeworms are likely to contaminate the feed and water of rabbits, and for that reason it is necessary to exclude stray dogs from premises where rabbits and rabbit feed are kept and to make sure that the rabbits have feed and water known to be free from contamination from dogs' droppings. Dogs kept on premises where rabbits are raised should not be allowed to eat any part of a rabbit carcass that is not known to be free of bladder worms or else cooked; thorough cooking invariably kills the bladder worms present in any part of the carcass. Dogs kept on rabbit farms should be examined occasionally for tapeworm infestation by a competent veterinarian, whose advice should be strictly followed.[21]

Rabbits harboring many bladder worms in the abdominal cavity do not thrive, their growth being considerably arrested and sometimes permanently retarded. Young rabbits that harbor numerous bladder worms in the abdominal cavity become pot-bellied. Since all the bladder worms in the abdominal cavity pass through the liver, this organ may be seriously affected. Deaths from heavy infestation with bladder worms have resulted from excessive injury to the liver and from injury to the peritoneum.

The many-headed bladder worm occurs in the tissues between the muscles and under the skin of rabbits and may also occur in

FIG. 17.—The many-headed bladder worm of the rabbit (*Multiceps serialis*). (From Railliet, 1895.) Approximately natural size

[19] *Taenia pisiformis.*
[20] *Multiceps serialis.*
[21] HALL, M. C. PARASITES AND PARASITIC DISEASES OF DOGS. U. S. Dept. Agr. Circ. 338, 28 p., illus. 1925.

the heart muscle, lung, and other locations. The cysts may occur as single bladders or as branching forms, sometimes attaining considerable proportions, ranging in size from a minute cyst to the size of an apple. (Fig. 18.) The presence of these cysts may be readily detected when they are fully grown, and the superficial bladders may be felt through the skin with the fingers. They are usually noticeable when under the skin of the face, neck, legs, back, and shoulder. The many-headed bladder worm often impairs locomotion by virtue of its location and weight, which may cause interference with muscular movement. It may occur in the orbit, and in this location it may injure the eye. Heavy infestations kill the affected animals.

Treatment for bladder-worm infestation is usually out of the question, though the many-headed bladder worm may be removed by operation if it is superficial and if the value of the animal warrants the operation. As the disease is not transmitted from one rabbit directly to another, there is no danger of the spread of this disease except through infested dogs and by means of feed and water contaminated with the feces of such dogs.

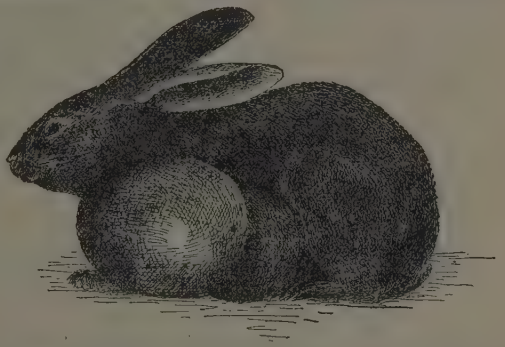

FIG. 18.—Rabbit, showing large cysts caused by subcutaneous bladder worms in the region of the shoulder. (From Moussu)

FLUKES

Several species of flukes have been reported from hares and rabbits, and of these, two deserve consideration. One form [22] is an intestinal parasite resembling a small seed and is about one twenty-fifth of an inch long and about half as wide. This parasite has been found in wild rabbits in the District of Columbia, Maryland, Virginia, New York, and Texas, and probably occurs in other parts of the country. The other form is the common liver fluke [23] of cattle and sheep and is flat and leaflike in shape, about 1 inch long and about half an inch wide, and occurs in the liver and bile ducts of the normal hosts and of other hosts, including wild and domestic rabbits.

Flukes have a complicated life cycle involving a snail intermediate host, in most instances. While the danger of fluke infestation in hutch rabbits is not very great, the possibility of introducing these parasites with hay or with green feed from wet and marshy places should be borne in mind. In certain sections of the South and on the Pacific coast and adjoining regions liver flukes are known to occur in cattle and sheep, and rabbit owners in those localities should take precautions not to introduce the infection into rabbitries with green feed or hay grown on or near places where fluke disease in cattle and sheep is known to exist.

[22] *Hasstilesia tricolor.* [23] *Fasciola hepatica.*

ROUNDWORMS

Stomach worms

The stomach worm of domestic rabbits in the United States [24] (fig. 19) is a very slender, cylindrical worm, about half an inch long, and more or less whitish in color. A very closely related form is known from these animals in Europe, but so far as as known the European stomach worm of rabbits [25] does not occur in the United States. The life history of the American stomach worm of rabbits has not been studied, but it is probably similar to that of the European form which has been investigated and is briefly as follows:

FIG. 19.—The American stomach worm (*Obeliscoides cuniculi*) of rabbits. A, Female; B, male. (From Chandler, 1924.) Enlarged

The eggs (fig. 20) produced by the female worms are elliptical in shape and are surrounded by a thin shell. On superficial examination they may be mistaken for coccidia. An egg is larger than a coccidial cyst, however, and has granular contents which segment, ultimately producing a larva, whereas the contents of a rabbit coccidial cyst ultimately develop into four sporocysts, each of which contains two sporozoites. (Fig. 13.) The eggs are eliminated with the droppings, and after a short period a small larva appears in each viable egg. The larva emerges from the egg and continues to develop, attaining the infective stage after a period of several days. Moisture and a certain degree of warmth are especially favorable to the development of the eggs and larvae of these worms. The infective larvae are swallowed by rabbits with feed and drink, and when they reach the stomach they presumably develop through the usual molts to maturity.

Several species of roundworms similar in size and appearance to the stomach worm are known to occur in the small intestine of rabbits (fig. 21), two species [26] appearing to be common in the United States. The life histories of the intestinal roundworms have not been studied, but it is probable that they are similar to that of the stomach worm.

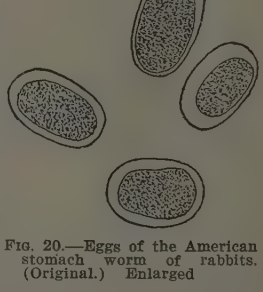

FIG. 20.—Eggs of the American stomach worm of rabbits. (Original.) Enlarged

Symptoms.— Roundworm infestation of the stomach and small intestine produces disturbances of various sorts that affect the health of rabbits, the degree of injury depending on the susceptibility of the rabbit and on the degree and nature of the infestation. Light infestations appear to produce little effect, but when the animals are heavily infested they may be emaciated, suffer from diarrhea, and often from anemia, and may even succumb to the

[24] *Obeliscoides cuniculi.*
[25] *Graphidium strigosum.*
[26] *Trichostrongylus calcaratus* and *Nematodirus leporis.*

disease. The stomach worm of American rabbits produces ulceration of the stomach wall. The worms adhere closely to the mucous lining of the stomach and may push their heads deep into the lining.

Roundworm infestation of the stomach and small intestine has been found in a severe form in Europe among rabbits kept on the ground. The animals were found to be extremely emaciated, weak, and unable to run away from dogs. In severe epizootics many animals died, and those that survived were of very little value.

Prevention.—In the absence of information as to treatment for stomach and intestinal roundworms in rabbits precautions should be taken to prevent the parasites from gaining a foothold in rabbitries. As the infective larvae are transmitted through the feces of infected animals, frequent cleaning of hutches constitutes a reasonable safeguard. All feed grown on ground that has been manured with rabbit feces should be avoided, as there is great danger of introducing in this way not only roundworm infestation but also coccidiosis. The droppings of animals suspected of harboring these parasites should be destroyed, and rabbits that appear weak, dull, unthrifty, and undersized should be isolated from healthy animals. Precautions taken to prevent coccidiosis also aid in controlling these roundworms.

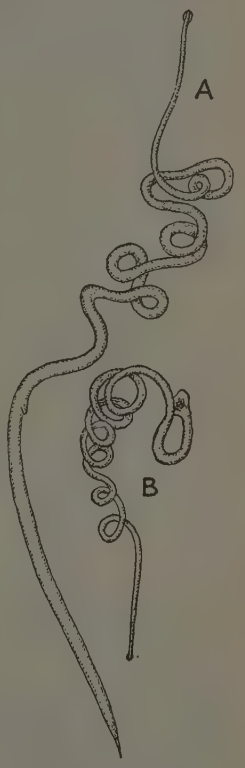

FIG. 21.—An intestinal roundworm (*Nematodirus leporis*) of rabbits. A, Female; B, male. (From Chandler, 1924.) Enlarged

Pinworms

Pinworms [27] (fig. 22) are whitish in color, the largest forms being about half an inch long. They are very common in both wild and domestic rabbits and occur in the cecum and large intestine. They frequently wander out of the body through the anal opening, and it is probable that they cause irritation in the anal region, as pinworms are known to cause this in other animals. The parasites spread from one animal to another by means of the eggs of the worm which occur in the droppings of the infested animals. Nothing is known at the present time regarding treatment of the pinworms in rabbits. The worms may be controlled to some extent by isolating infested animals and taking special precautions to destroy their droppings, preferably by burning or by plowing them under on areas remote from those on which rabbit feed is grown. Thorough cleaning of rabbit hutches at frequent intervals helps to control these parasites.

[27] *Passalurus ambiguus.*

Whipworms

Rabbits harbor whipworms[28] (fig. 23) in the cecum. The largest specimens are more than an inch long and consist of a long, slender portion, which is commonly attached to the lining of the cecum, and a thicker portion, which is free in the lumen of this organ. Whipworms are said to feed on serum; and while the extent of their injury to rabbits is unknown, they are not to be regarded as harmless parasites. There is no known treatment for these parasites in rabbits. Prevention should be based on the same principles as the control of pinworms and of other worm parasites.

Lungworms

Two species of lungworms have been reported from domestic rabbits. One of these worms[29] is the sheep lungworm and is primarily a parasite of sheep and goats and only a rare parasite of rabbits, whereas another species of lungworm[30] is a parasite of wild rabbits and has also been found to occur occasionally in domestic rabbits. On the whole, lungworms do not appear to be common in domestic rabbits. Lungworms of rabbits are very slender, brownish red in color, and the largest specimens are less than an inch in length. They occur in the bronchi and in the deeper spaces of the lungs. The eggs of the sheep lungworm develop and hatch in the air spaces of the lungs, and the young worms pass from there to the bronchi and thence into the windpipe, from which they reach the mouth and are usually swallowed, passing out in the droppings. The young worms can live for some time in water and are capable of living for a long time under unfavorable conditions, including dryness. Lungworms in sheep and in other animals produce a bronchopneumonia which may terminate fatally. No effective treatment for lungworm infestation is known. Prevention consists in isolating sick animals from healthy ones and in thoroughly disinfecting the hutches in the way indicated in connection with coccidiosis.

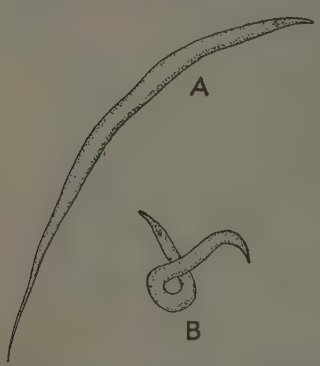

FIG. 22.—The pinworm of rabbits (*Passalurus ambiguus*). A, Female; B, male. (Original.) Enlarged eight times.

SANITARY MEASURES TO CONTROL PARASITES

From the foregoing account of the parasites of rabbits and their method of spreading from one animal to another, it will be seen that if great care is given to general sanitation of rabbitries the chances of spreading parasitic diseases are greatly reduced. Hutches that are kept in a clean and dry condition do not favor the develop-

[28] *Trichuris leporis.* [29] *Synthetocaulus rufescens.* [30] *Synthetocaulus commutatus.*

ment of coccidia cysts and of worm eggs. Damp, ill-kept hutches, full of manure which is kept continually moist by admixture with urine, constitute a favorable place for the infection stages of coccidian and of other parasites, and these may retain their vitality for a long time. Hutches should therefore be of sanitary construction designed to allow the fecal pellets to drop through the bottom and the urine to drain. The feces and urine should drop into a tray which should be emptied frequently and then scrubbed and scalded with boiling water before being replaced. The contents of the tray should not be dumped near the rabbitry but should be removed to a place remote from the rabbitry and should be burned or plowed under. Under no circumstances should rabbit manure be placed on ground where rabbit feed is grown, and unless this precaution is scrupulously followed parasites will probably be prevalent in the rabbitry.

Dishes for water and feed should be scalded daily, as they are very likely to become contaminated with pellets, even though the hutches are of sanitary construction. All loose litter should be removed from the hutches daily and should be destroyed, preferably by being burned; and the hutches should be disinfected at intervals of two days, when coccidiosis is present, with boiling water or by washing with a strong coal-tar-creosote solution. The process of disinfection should be thorough, care being taken that the boiling water or chemical disinfectant penetrates all cracks and crevices of the hutches. Secondhand hutches should always be disinfected thoroughly before being used, as they are likely to be contaminated with coccidian cysts and with eggs and larvae of worms.

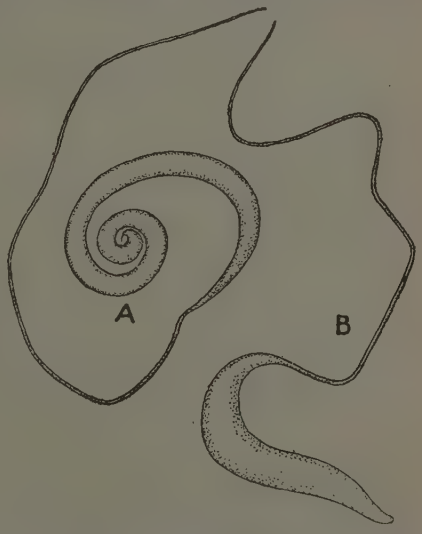

FIG. 23.—The whipworm of rabbits (*Trichuris leporis*). A, Female; B, male. (Original.) Enlarged

Only clean feed and water should be given to rabbits, and the feed and water should be placed in containers well above the floor of the hutches so as to prevent their becoming contaminated with the droppings. Good feed, fresh air, and plenty of light are important aids in combating diseases of various sorts, including parasitic diseases. All stray dogs should be excluded from rabbitries, and any dogs kept on premises near rabbitries should be free from tapeworms. Systematic examination and treatment for tapeworms of dogs kept on the premises are important preventive measures.

It is desirable that quarantine hutches be maintained at some distance from the rabbitry and that all sick animals and animals sus-

pected of harboring parasites be kept in quarantine until known to be healthy, and that all new stock be kept in quarantine for at least two weeks. This precaution should also be followed, if possible, with reference to buck rabbits that may be introduced for service. Animals kept in quarantine should be closely watched for symptoms of disease, and a microscopic examination of the feces for worm eggs and coccidia should be made by a competent person. If coccidia are found, rabbits showing this infection should be entirely excluded from the rabbitry. The same procedure should be followed in cases of infestations with worms.

Whenever coccidiosis and other parasitic conditions are suspected of being present, it is advisable to employ a veterinarian. One or more rabbits showing symptoms of parasitism should be killed, and the alimentary canal should be slit open in order to determine whether worms or coccidia are present. The liver should be examined for white spots. Specimens of parasites or of diseased tissue should be forwarded to a competent zoologist or veterinarian for diagnosis.

Inasmuch as healthy adult rabbits are often carriers of coccidia and other parasites, it is best to separate young from adult rabbits as soon as possible. For the same reason young animals should be raised on clean areas not previously occupied by older animals. Flea-infested dogs, cats, and poultry should be kept away from areas occupied by rabbits.

Young animals of all sorts are especially susceptible to infestation with parasites and suffer more severely than older ones from the effects of parasitic infestation. It is therefore highly important to take all possible precautions to prevent young rabbits from becoming infested with parasites. The setback that they may receive early in life as a result of parasitism may seriously impair their growth and vitality and make them permanently weak and unthrifty.

Special precautions should be taken in cleaning and disinfecting the hutches in which pregnant does are placed, by removing all litter and thoroughly cleaning and scrubbing the hutches. The bedding that is placed in them should be free from possible contamination with rabbit or dog manure. Before the doe is placed in the kindling hutch, all litter adhering to the surface of the doe should be removed by hand and with a brush.

Only clean feed and pure water free from possible sources of contamination should be introduced into these hutches. With these precautions the opportunities for the young rabbits to acquire parasites will be considerably lessened. Care should be taken that no litter of any sort from hutches in which mature rabbits are kept is introduced into hutches containing young animals, and as far as possible kindling hutches should be isolated from other hutches.

These precautions will not only help to control parasitic diseases but may also help to control, to some extent, bacterial infections. If young rabbits are tided over the period of life during which they are most susceptible to diseases of various sorts, losses from disease later in life may be considerably diminished.

BACTERIAL AND OTHER DISEASES

By W. B. Shook

Once disease breaks out in a rabbitry, measures should be taken to limit its spread as quickly as possible. The medicinal treatment of rabbits sick from an infectious disease is usually an impracticable procedure, unless only a few are being raised and, indeed, even in these cases the value of such treatment is questionable.

Sick animals should be isolated, and in cases when the mortality is high such animals should be destroyed as soon as possible so as to remove all centers of infection quickly. The carcasses of all animals should be burned or buried. The hutches and all utensils used in feeding and watering should be thoroughly cleaned by scrubbing them with a hot soda solution and disinfected with 3 per cent compound cresol solution or 5 per cent carbolic acid or other suitable disinfectant. All bedding and litter should be burned.

To determine the nature of the infection causing an epizootic a post-mortem examination is usually necessary and in many cases should include an examination by a trained bacteriologist. When laboratory aid is required a sick rabbit or one recently dead should be furnished. As post-mortem changes in many cases obscure pathological conditions and render the specimen unsuitable for bacteriological study, it is essential that the carcass be in as fresh a condition as possible. The body of a rabbit that has just died should be selected, packed in ice or completely covered with powdered borax. A complete history of the epizootic, together with the method of feeding and housing should also be furnished. Most cities have commercial laboratories which perform bacteriological work for physicians and veterinarians, through whom arrangements may be made.

HEMORRHAGIC SEPTICEMIA

Hemorrhagic septicemia, or rabbit septicemia, is an acute infectious bacterial disease, caused by the *Pasteurella cuniculicida* (*Bacterium lepisepticum*). The disease may be contracted by the ingestion of food or water contaminated with the virulent organism, or by direct contact with infectious material. It has a high mortality when it gains entrance into a rabbitry. As a rule the disease runs a rapid course, the animals usually dying in 24 to 36 hours.

Symptoms.—There is a high temperature, lusterless coat, inappetence, and there may be a diarrhea. The animal is droopy and soon succumbs to the infection. In many rabbitries where snuffles is present, some of the animals may die of a general infection due to the hemorrhagic-septicemia germ.

Post-mortem.—Findings in the acute cases may show no marked changes as the animal dies of a septicemia. However, when lesions are found they consist of hemorrhagic areas in or on one or more of the various organs or on the linings of the body cavities, or in the alimentary canal. Pneumonic areas may also be found in the lungs.

Treatment.—Treatment of affected animals is of no avail. Sick animals should be isolated and properly destroyed. Hutches which have been contaminated by sick rabbits should be thoroughly cleaned

and disinfected before being used by healthy stock. Carcasses of rabbits dead of the disease should be burned or buried.

Preventive treatment in the noninfected animals, by the administration of hemorrhagic-septicemia bacterin or aggressin is indicated, but this should be undertaken only by a veterinarian.

CONTAGIOUS NASAL CATARRH (SNUFFLES)

Contagious nasal catarrh, usually called snuffles, is a contagious disease, characterized by inflammatory disturbances of the mucous membrane of the nasal passages, windpipe, and lungs, and sinuses of the head.

Cause.—While there is still an element of doubt regarding the cause of the disease, there are at least two germs which are constantly found either singly or together in the nasal discharges and affected tissues. They are known as *Alcaligines bronchisepticus* (*Bacillus bronchisepticus*) and *Pasteurella cuniculicida* (*Bacterium lepisepticum*). These organisms have at times been found in the air passages of apparently normal rabbits, and it has been suggested that certain unfavorable conditions tending to lower the resistance of such animals enable the germs to assume a true disease-producing rôle with enhanced virulence.

Symptoms.—In its most common form the affection runs a chronic course manifesting itself in symptoms of persistent, white, tenacious, nasal discharge, frequently accompanied by crust formation on the nostrils. There is sneezing and apparent nasal obstruction, with a marked tendency for the animal to rub its nose with its paws, the fur of which soon becomes soiled and matted. As the disease progresses there is loss of appetite and considerable wasting away and weakness often leading to death. In many instances animals appear to become adapted to the chronic disease and survive with little loss of weight. In some cases there may be well-marked symptoms of nasal catarrh and loss of appetite and weight, which subside after a number of days, and the animals return to normal.

Later the same animals under conditions which lower their resistance may again develop symptoms of the disease. Several such attacks may occur during the course of a year. Occasionally the affection is acute, the animal dying after a few days' illness, manifested by symptoms of pleurisy or pneumonia. In some cases abscesses develop under the skin of the abdomen, the back, at the base of the ears, or on the legs. They may occur singly or in clusters and vary in size from that of a pea to that of an egg or larger. The contents of the abscess are usually yellowish-gray in color and of a dry, cheesy consistence.

Treatment.—Occasionally a mild transitory inflammation of the nasal mucous membrane with a slight discharge of mucus may be mistaken for snuffles. Such cases should be isolated in dry, well-lighted hutches, ventilated so as to prevent sudden changes of temperature, and held under observation until the true nature of the affection is determined. Once snuffles is definitely diagnosed, no medicinal treatment appears to be adequate. It has been found more profitable to destroy the animals as quickly as possible after the onset of symptoms and to burn or bury the carcasses than to attempt either isolation or treatment.

All new stock should be isolated in separate hutches for at least two weeks and precautions taken by means of disinfection to prevent infection being carried by the attendant, or else they should be cared for by a special attendant.

TULAREMIA

Tularemia is a specific, infectious, bacterial disease caused by *Pasteurella tularensis* (*Bacterium tularense*). While this disease has been reported only in wild rabbits, it has been proved experimentally that domesticated rabbits are also susceptible to the disease. Tularemia assumes importance from the fact that it can readily be transmitted to man, and while it has not been reported in domesticated stock, the proved susceptibility of such stock and the transmissibility of the disease to man warrant its discussion with other diseases of rabbits.

The disease is carried from infected rabbits to healthy stock by the wood tick (*Dermacentor andersoni*), the rabbit tick (*Haemaphysalis leporis palustris*), the deer fly (*Chrysops discalis*), and the rabbit louse (*Hæmodipsus ventricosus*).

The disease is transmitted to man by the deer fly, the wood tick, or by the handling and dressing of infected rabbit carcasses.

Post-mortem.—An animal dead of the disease usually shows numerous necrotic spots in the liver and spleen, while besides these lesions, in laboratory animals infected by inoculation, the lymph glands, especially in certain parts of the body, as the abdomen and groin, are swollen and inflamed and sometimes contain pus.

As a safeguard to those handling wild rabbits during the hunting season or otherwise, it is very important to use rubber gloves when dressing rabbits. This is especially advised when the disease is known to exist in a particular locality.

Treatment.—Treatment of this disease is of no avail and should not be undertaken on account of the susceptibility of man to infection. Once the disease has been diagnosed, all sick animals should be destroyed and the entire carcasses burned or buried deeply. The hutches should be thoroughly cleaned and then disinfected with 3 per cent compound cresol solution or other suitable disinfectant.

Tularemia has been found to exist in small wild animals in Utah, Montana, Wyoming, New Mexico, North Carolina, Virginia, and other States.

NECROBACILLOSIS (SCHMORL'S DISEASE)

Necrobacillosis, also known as Schmorl's disease, may be defined as a bacillary necrosis, characterized by a progressive ulceration of the skin of various portions of the face or by abscess formation in different regions of the body. The causative organism, known as *Actinomyces necrophorus* (*Bacillus necrophorus*), is found widely distributed in nature and may enter the body through wounds produced by scratching, biting, or coarse food.

Symptoms.—The symptoms vary considerably, depending on the point of entry of the germ. The infection may at first cause a painful purplish swelling of the upper lip which gradually spreads until the skin of the whole face is involved. In other cases the infectious process may begin as a swelling of the lower lip and extend slowly

under the jaw and throat to the region of the breast. There is a gradual death of the affected skin and underlying soft tissues with eventual sloughing. The surface of the wound thus exposed has a dirty, grayish-white appearance, is somewhat dry, and relatively free from pus. The deeper parts of the affected areas are hard and necrotic. While the disease is progressing in the region of the head, there may occur more or less severe ulcerations of the skin of the hind legs and around the vent. In still other instances there may be no involvement of the face, but the abscesses may occur on the thighs, flanks, undersurface of the body, or other regions. These abscesses form rather slowly and range from pea size to walnut size. The wall of the abscess is composed of thick, tough, fibrous tissue, and it contains a thick, creamy, and, at times, cheesy pus. The affected animals have great difficulty in moving the jaws and in consequence eat very little. They become weak and emaciated and, after a period of illness lasting from two to several weeks, succumb to the disease.

Post-mortem.—There may be found besides the external lesions rather marked swelling of the glands about the head, throat, and groin. Theer may be evidence of pneumonia and areas of consolidation in the lungs and an excess of cloudy fluid in the chest cavity and heart sac. Abscesses similar to those occurring under the skin may be found in the internal organs.

Treatment.—Treatment of the disease is largely surgical, but is usually not successful, except in the case of a few local abscesses, and even in such cases, unless the entire wall of the abscess is removed by carefully dissecting away from the healthy tissues, healing will not occur. Preventive measures are most important and consist in destroying the affected rabbits, burning all litter and soiled food material, cleaning and disinfecting the hutches, buildings, utensils, and feeding and watering receptacles. A complete change of food is often advisable.

PNEUMONIA

Pneumonia is a common disease of the rabbit and in the majority of cases is fatal, the animal dying in from two to four days.

The disease may be caused by direct exposure to drafts, sudden changes in temperature, and to damp and insanitary quarters. It accompanies certain infectious diseases.

Symptoms.—The animal is droopy, refuses food, the breathing is labored, there is a fever, the eyes may be watery, and there may be a mucous pussy discharge from the nose.

Post-mortem.—The lungs are the seat of the disease and may show numerous consolidated or liverlike areas. Both lungs may be wholly involved, or the lesions may be confined to portions of one or both lungs.

Treatment.—Since pneumonia in the majority of cases is fatal, treatment is usually of no avail. Insanitary conditions should be corrected if they are the cause, and suitable quarters prepared for the animals. As the disease is often infectious, the usual precautions of isolation and cleaning and disinfection should be taken.

STREPTOBACILLARY PSEUDOTUBERCULOSIS

As the name implies, this is an infectious disease resembling tuberculosis but caused by a specific germ known as *Corynebacterium*

rodentium (*Streptobacillus pseudotuberculosis rodentium*). Outbreaks of the disease may occur in rabbits of any age, and the mortality is high.

Symptoms.—There is weakness, emaciation, difficulty in moving about, inappetence, and labored breathing, especially pronounced during an exertion. The affection runs a chronic course, usually terminating in death.

Post-mortem.—Examination reveals a rather marked degree of emaciation, numerous small, whitish, cheesy nodules scattered throughout both lungs, and similar nodules in the liver and spleen. The kidneys also are sometimes the seat of such nodular lesions. The intestinal tube, particularly the blind gut, is studded with nodules.

Treatment.—No treatment is recommended, but rather the prompt destruction of the affected animals, removal of healthy stock to uncontaminated quarters, and the thorough cleaning and disinfecting of the houses, utensils, and premises. On account of the similarity of the disease to true tuberculosis, coccidiosis, and certain parasitic affections, an early diagnosis is often difficult; therefore laboratory aid should be sought.

INDIGESTION

Indigestion in the rabbit is frequently due to injudicious or excessive feeding and especially to the exclusive feeding of succulent green stuffs. Abrupt changes in the ration may also be productive of digestive disturbance. Keeping rabbits in cold, damp, dark, or poorly ventilated hutches, or under otherwise insanitary conditions tends to render them more susceptible to digestive disorder.

Symptoms.—The symptoms are dullness, lack of appetite, restlessness, colic, and sometimes diarrhea. In the acute form of the disease there may be an excessive secretion of saliva, which drools from the mouth and wets the hair about the jaws.

Treatment.—Provide dry, comfortable quarters, withhold all food for 24 hours, then allow only water for another 24 hours. After that a diet of bread and sweet milk may be offered to the animal for several days. Hay, grains, and carrots may then be fed in moderate quantities. As a corrective give 5 to 10 drops of the aromatic syrup of rhubarb or 5 grains of bicarbonate of soda dissolved in a teaspoonful of warm water.

In case of diarrhea it is advisable to withhold all fresh green foods, allowing only well-cured hay and such digestible cereals as rolled oats or barley meal.

DIARRHEA (SCOURS)

Causes.—Besides being a symptom of certain infectious diseases and parasitic infestations, diarrhea of rabbits, especially young animals, is frequently brought about by sudden changes of weather, damp, insanitary hutches, excessive quantities of green foods, musty hay or grain, or any circumstance tending to lower the general vitality.

Symptoms.—The symptoms are loose, watery, offensive bowel movements, which cause extreme weakness and sometimes depression in the animal.

Treatment.—Provide a clean, dry hutch, well bedded with dry straw or sawdust.

Discontinue all green foods, substituting boiled rice and scalded milk. A powder consisting of 3 to 6 grains of bismuth subnitrate and 5 to 10 grains of bicarbonate of soda may be given in a teaspoonful of warm water twice daily.

When the symptoms of the disease have disappeared the animal should be restored by gradual degrees to a normal, balanced ration consisting of greens or succulent roots, in addition to suitable clean grains and well-cured hay.

CONSTIPATION

Causes.—Constipation is somewhat rare in rabbits, being confined principally to those that are overfed, or maintained on an exclusive ration of concentrated feeds, such as grains, with little or no green stuff. Sometimes hairs are swallowed with the food, and these form a ball in the intestine, obstructing the digestive tract. Sudden exposure to extreme cold may also bring about a suppression of the muscular activity of the bowels, causing constipation.

Symptoms.—The rabbit sits in a huddled position, dull and indifferent to food. The bowel movements, if any, consist of small, hard dung pellets, covered with mucus, and sometimes adhering one to another.

Treatment.—Correct the diet by feeding some succulent vegetable matter, such as cabbage, roots, or any of the green feeds relished by the animal.

Give the affected rabbit one-fourth to one-half teaspoonful of Epsom salt dissolved in water, or 1 to 2 teaspoonfuls of castor oil, according to the size of the animal.

SORE HOCKS

Cause.—The occurrence of sore hocks is not uncommon in domesticated rabbits, owing to close confinement under insanitary conditions. In poorly kept hutches, where the droppings accumulate and become saturated with urine, this ammonia-laden filth becomes intensely irritating to the hocks, rendering them tender, inflamed, swollen, and cracked. If this condition is neglected, the affected parts may become ulcerous, and infection may ensue.

Treatment.—Thoroughly cleanse the hutches and keep them clean. Wash the sore hocks of the affected rabbits, using warm water and soap, and then apply iodoform or a 1 per cent compound solution of cresol. The animals should be well bedded with dry leaves or straw until fully recovered. In case of the formation of an abscess, this should be opened, drained, and irrigated with hydrogen peroxide until thoroughly cleansed. Finally a weak tincture of iodine should be introduced into the cavity by means of a cotton swab.

Prevention.—When rabbits are kept on hard floors, their hocks should be examined at frequent intervals. At the first sign of bareness or tenderness, the soles should be anointed once each day with zinc-oxide ointment or carbolated petrolatum (1 per cent).

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